Statewide Measurement and Verification
Presented to:

Public School Capital Outlay Oversight Task Force
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By:

Robert Gorrell, Executive Director, PSFA

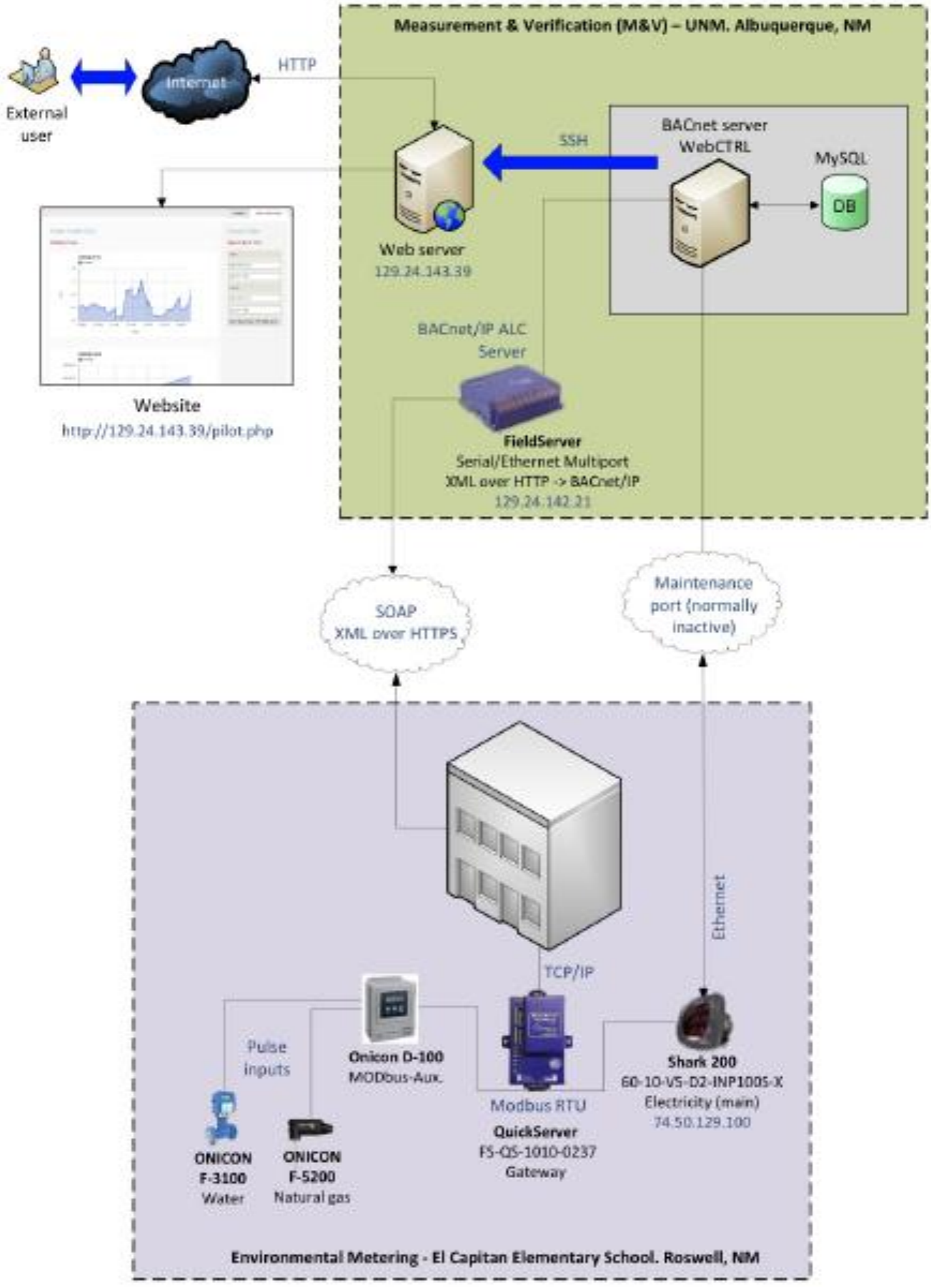
The Measurement and Verification (M&V) program is an initiative developed over the past two years by PSFA, UNM, the Energy, Minerals, and Natural Resources Department (EMNRD), and the US Department of Energy (DOE). The program makes utility information available to the State, UNM, and to the school district by installing revenue-grade electric, water, and gas submeters in New Mexico schools using internationally-accepted communication standards and off-the-shelf equipment. The pilot installation at Roswell El Capitan ES was completed in FY14, with database and website development going on in FY15. Information will be publicly available for download from UNM.

HM61 charges the PSCOC, PSFA, EMNRD, and others with conducting a study and making recommendations regarding statutory, regulatory, and administrative changes necessary to broaden and accelerate public facility use of cost-saving, efficiency and water-saving measures. This M&V program is the first step to accomplishing that goal. It also provides resources to school districts to give them the information they need to make local changes in order to more efficiently utilize their resources. In addition, the data provides a real life learning opportunity for students, who will have access to use data in their classrooms.

Benefits of the M&V Program:

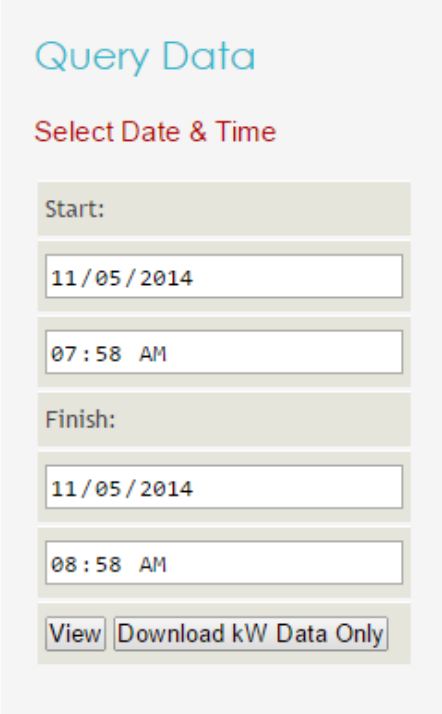
A. *School Facilities* – Real-time measurement for energy management, and identification of problem areas.
B. *STEM Educators* – Real-time energy and water data for classroom curriculum and analysis, including meters that would otherwise be inaccessible in secure utility closets.
C. *State of New Mexico* – Functional transparency with high-quality energy data to identify needs and opportunities among New Mexico schools. Also provides analysis information to see what systems do (or don't) perform well in the field, allowing the state to make the most informed decision based on best practices in future projects.
D. *NM Higher Ed* – the UNM engineering programs will have access to information from hundreds of different buildings and system types in three different climate zones. This would provide a competitive advantage for New Mexico university research programs. No other university currently has instrumented buildings with a statistically significant sample of building types or climate zones. The DOE funded this FY14 systems pilot specifically to collect this kind of information.

How it Works – a Graphic Representation:



Classroom Use:

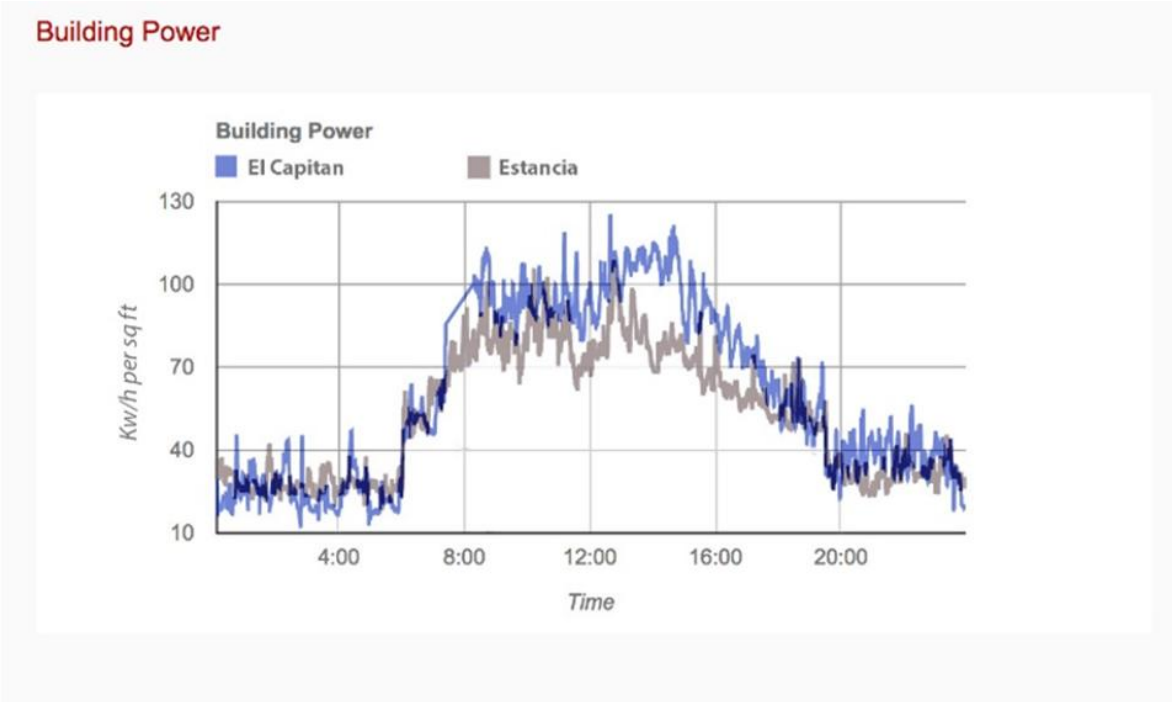
Users are given the option of collecting information for a specified time period as shown below (from the Web pilot interface).



kW use data can be accessed on a minute by minute basis and exported for analysis.

11/4/2014 6:26	60047.72
11/4/2014 6:26	60047.72
11/4/2014 6:26	60047.72
11/4/2014 6:26	60122.31
11/4/2014 6:26	60122.31
11/4/2014 6:26	60779.32
11/4/2014 6:26	60779.32
11/4/2014 6:26	60779.32

In addition to exportable data, the website also shows visual representation of power, energy, gas, and water use.



STEM Curriculum

In addition to the benefits this program offers to facility managers, the information collected can also be incorporated into the classroom. The term 'STEM' refers to science, technology, engineering, and math, which is the core focus of primary education programs. STEM generally supports study of engineering within each of the other subjects, and integrating the curriculum of each subject.

STEM uses project-based learning to involve students in solving authentic problems, working with others, and building real solutions (Fortus, Krajcikb and Dershimerb)[i]. In general, STEM education focuses on real-world, authentic problems, where students learn to reflect on the problem-solving process.

The data collected from the M&V can be directly intergraded into the STEM curriculum and lesson plans and will allow students to analyze real data from their school. In conjunction with the STEM applications of this data, students can also create plans for reducing resource consumption. Teachers can use this information for students to practice their computer, writing, and presentation skills. The information provides an ever-changing and endless resource for innovative educators to allow their students to create plans and implement changes where they can see a result in real time, minute by minute. Teachers already participate in these kinds of projects by having students audit their usage, but the information they can collect is limited by the availability of the meters and tools needed, as many meters are located in electrical closets where they are inaccessible to students. (A sample curriculum is attached as Appendix A.) Through the M&V Program, educators can pull accurate, real time information into the classroom with the click of a button.

El Capitan Pilot

A pilot of the program has been implemented at El Capitan Elementary School in Roswell. The Energy Manager had this to say about the program:

> *To whom it may concern:*
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> *The M&V program can be very helpful to students in the RISD. In math, students can monitor the energy being used on a daily, weekly, and monthly basis. Students can graph the usage and costs and see whether the school is conserving or using too much energy and compare with other schools in the district. Students can see how turning off lights, computers, etc can affect the usage and costs. Students can use various equipment to help measure usage. Students can see and measure how effectively holiday shutdowns effect our bills. Understanding HVAC and its impact on education can help administrators to achieve higher educational results in their students. The M&V program can be utilized by students, teachers and administrators to gain knowledge of the energy program, to teach curriculum, and to conserve energy. The M&V program is a great step in helping individuals understand the importance of energy conservation through monitoring usage.*
>
> *Thank you,*
> *Paul V. Mysza*
> *Energy Manager, Roswell Schools*

Energy Consumption and Problem Prevention:

The Energy Efficiency and Renewable Energy Bonding Act requires the EMNRD to perform an assessment at the request of the state or a school district to determine specific efficiency measures which will result in energy and cost savings. HM61 requires that recommendations be made to expand and optimize the use of the Act's funding resources. The M&V Program will provide access to real-time energy performance data and will allow energy service companies to quickly locate savings opportunities before investing in site visits or assessments.

School district will also have access to better information to anticipate or catch problems. Just as a spike in consumption might indicate a performance malfunction or maintenance opportunity for the district or state, so also any school that is consuming more than its size and equipment should warrant could be seen as an energy performance opportunity worth further investigation by private contractors or Energy Service Companies (ESCs). Having widespread information at a low cost should remove market barriers and allow a much more competitive market, resulting in lower prices and a 'better deal' for school consumers. After work is done, having real metering information with third party (UNM) verification should serve as a fair measure of savings; far better than any vendor estimates or even the utility bills.

Estimated Cost of Program Implementation:

Basic hardware price per school	$13,057
Material (conduit, wire, boxes etc.)	$1,500
Labor	$9,705
Contingency 5%	$1,213
NMGRT 8%	$2,038
Total per school	$27,513

Public schools	784
Public Charter Schools	100
	884

Total estimated cost for 784 schools	$22,000,000
Total estimated cost for 884 schools	**$25,000,000**

Conclusion:

For a cost of $27,513 per school, the state can move to the forefront of public school energy programs in the United States, while also benefiting STEM research in secondary education. Other states have submetering programs for schools, but no other state has a single system with all information publicly available to all users, just as no other university has this amount of real-time data for engineering analysis. The opportunity is great. School districts will have better information to enforce their local authority and make better utilization decisions, while classrooms will have access to real time information to incorporate into their lessons so that students can really understand how they

influence the efficiency of their building every single day. The costs of running buildings will go down as problems get noticed sooner and districts have first-hand knowledge of their own consumption. New Mexico will have the opportunity to become a model for other states as we put the data collected by this program to good use in current resource use and in future decisions regarding various energy efficient systems and the settings and situations that they are best suited for. For a total of around $25 million, every school in the state can be outfitted with the materials needed to implement this program, which will positively benefit the state in monetary and non-monetary ways for years to come.

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[i] Fortus, D, et al. "Design-Based science and real-world problem sovling." International Journal of Science Education (2005): 855-879.